Management Recommendations for

Hydrothyria venosa J.L. Russell

version 2.0

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SUMMARY

Species: *Hydrothyria venosa* J. L. Russell
Taxonomic Group: Lichens (Aquatic)
ROD Components: 1,3
Other Management Status: None

Range: In the range of the Northwest Forest Plan, *H. venosa* is known from 53 sites, 28 in Washington and 25 in Oregon, all on federal land. In Washington, it is known from Mt. Baker-Snoqualmie National Forest; Mt. Rainier National Park; Olympic National; and the Gifford Pinchot National Forest, and Carson National Fish Hatchery. In Oregon, it is known from Willamette National Forest; Mt. Hood National Forest; Deschutes National Forest; Siuslaw National Forest; and Crater Lake National Park. *Hydrothyria venosa* is a North American endemic occurring in all major mountain ranges, where it is uncommon.

Specific Habitat: This aquatic lichen grows primarily on rocks ranging from small gravel to bedrock, and occasionally on wood submerged in small, clear, cold mountain streams between 1150-7000 ft (350-2133 m) elevation. It has also been reported from concrete head boxes at a fish hatchery, and on the inside lip of a galvanized culvert. It is occasionally found on exposed rocks above low flow levels, where hydration from splash and humidity are high. While it can be abundant in some streams, it is often absent from streams with suitable habitat.

Threats: Potential threats may be actions that alter stream conditions, including water quality, chemistry, temperature, light regime, level, opacity, or sediment levels; reduce streambank stability; or change the microclimate conditions associated with riparian vegetation. Road building, restoration and decommissioning activities, including culvert placement and removal, and fish habitat enhancement projects involving instream structures are also threats. Activities at sites upstream could affect downstream populations.

Management Recommendations:
- Because dispersal may be limited between streams, maintain *H. venosa* in each stream where it occurs.
- Maintain stream conditions necessary for survival of *H. venosa*.
- Evaluate effects of treating riparian vegetation on populated stream reaches.

Information Needs:
- Determine if *H. venosa* meets the criteria for close association with late-successional/old-growth forests.
- Determine the ranges in stream conditions necessary for survival of *H. venosa*.
- Determine the natural range of riparian canopy conditions necessary for survival.
- Determine mechanisms and rates of reproduction, dispersal distance and growth.

Management Recommendations for *Hydrothyria venosa*

I. NATURAL HISTORY

A. Taxonomy and Nomenclature

Hydrothyria venosa J.L. Russell was described by Russell in 1856 (Proc. Exxes. Sust. 1:188-191).

B. Species Description

1. Morphology

Hydrothyria venosa is a non-stratified, or gelatinous lichen with cyanobacteria scattered throughout the thallus. The thallus consists of dark, lead-colored to brown or blackish, tufted suberect medium-sized (about 2 cm) lobes, with distinct brownish veins on the underside and small- to medium-sized pinkish apothecia sessile on the upper surface (Figure 1). It is the only gelatinous lichen with distinct veins, and is the largest strictly aquatic lichen in the area. It occurs in small, cold, clear streams where it appears in dark, ruffled masses. Ear lobe-like discs of non-lichenized *Nostoc* (the cyanobacterium also occurs in *H. venosa*) are often present on submerged rocks in *H. venosa* habitat, but are more jelly-like and non-veined (McCune and Geiser 1997).

Technical Description: Thallus foliose, gelatinous (non-stratified), medium-sized, lead-colored to brownish or blackish, loosely lobed, the lobes fan-shaped, lobes irregularly cut, obtusely crenate towards the margins, tufted and suberect; bearing prominent brown branched veins below; apothecia small to medium size, 0.75-3.5 mm across, sessile and submarginal, the disk flat to convex, brown to reddish-brown, the exciple becoming torn-dentate and disappearing; spores fusiform-ellipsoid, 24-32 x 7-8.5µm, 8 per ascus, 3-septate; photobiont short chains of *Nostoc* scattered throughout the medulla; spot tests negative (Fink 1935:171).

2. Reproductive Biology

Hydrothyria venosa reproduces sexually by producing fungal spores in apothecia. Because the species is aquatic, the spores are probably distributed primarily by flowing water. Aquatic invertebrates that graze on this lichen and ingest spores could also be dispersal vectors, as could dippers and other birds, and the downstream movement of colonized rocks. The species also reproduces by thallus fragmentation as water turbidity increases and pieces of thalli drift downstream.

3. Ecological Roles

Little is known about the ecological roles of this freshwater lichen. It fixes nitrogen and

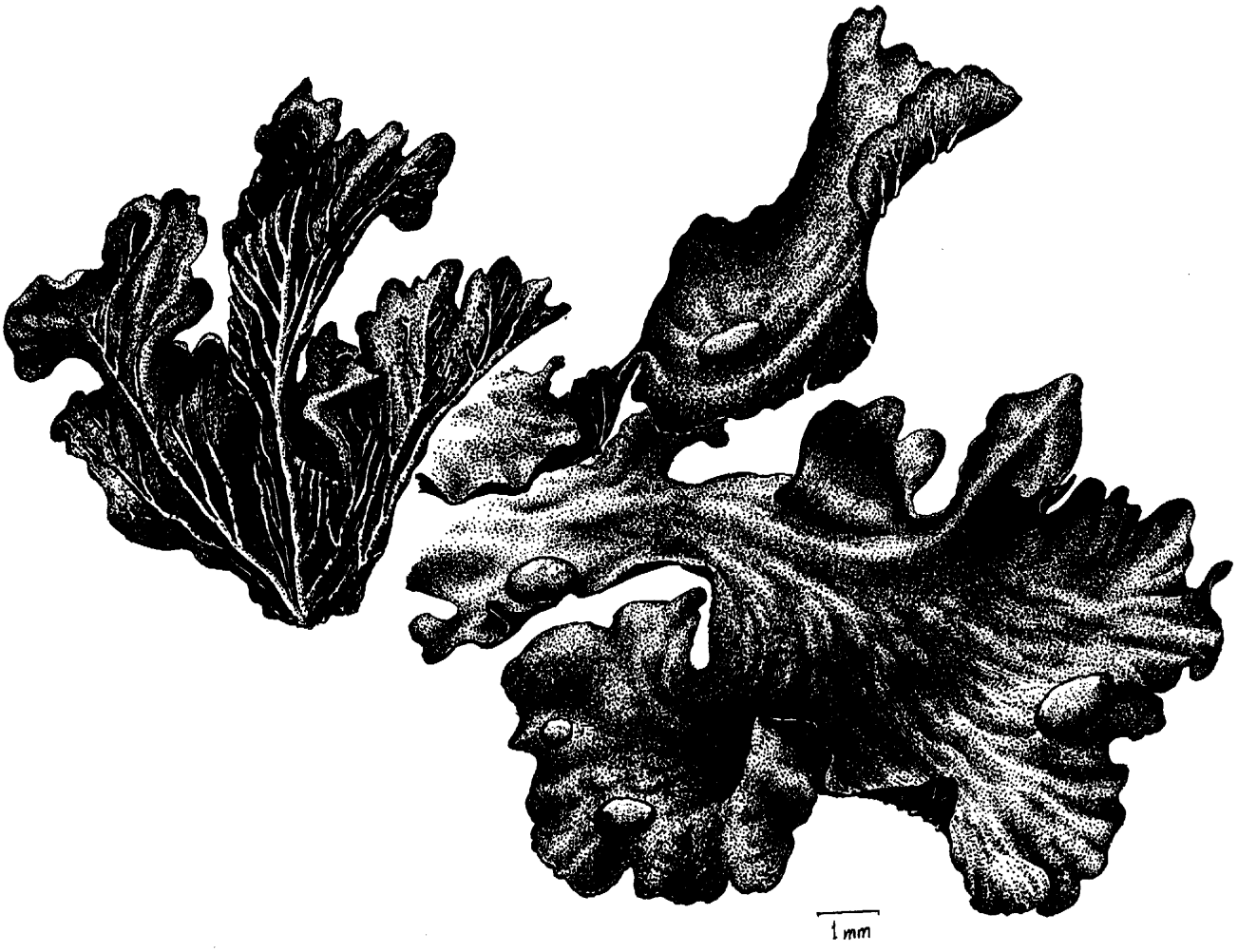

Figure 1. Line drawing of *Hydrothyria venosa* by Alexander Mikulin.

contributes an unknown amount of nitrogen to aquatic ecosystems. The species may provide forage and cover for some aquatic invertebrates, which in turn are food for fish. Many invertebrates, including protozoans, nematodes, rotifers and tardigrades, use aquatic lichens as food and habitat (Gerson and Seaward 1977). *Leptogium rivale*, another nitrogen-fixing aquatic lichen, is often present at the same sites as *H. venosa*. These lichens share the same photobiont, the cyanobacterium *Nostoc*, which is often present in its free-living form in streams with both lichen species. The relation between these three species is unknown. Aquatic lichens are presumed to be good indicators of water quality (USDA Forest Service and USDI 1994b).

C. Range and Known Sites

In the range of the Northwest Forest Plan, *H. venosa*, is known from 53 sites, 28 in Washington and 25 in Oregon, where it is almost exclusively montane. All sites are on federal lands. In Washington, it is known from the Mt. Baker-Snoqualmie National Forest (Whatcom and Snohomish counties); Mt. Rainier National Park (King and Pierce counties); Olympic National Park (Clallam and Jefferson counties); and the Gifford Pinchot National Forest and Carson National Fish Hatchery (Skamania County). In Oregon, it is known from Willamette National Forest (Lane, Marion and Linn counties); Mt. Hood National Forest (Marion, Clackamas and Hood River counties); Deschutes National Forest (Deschutes, Lane and Jefferson counties); Siuslaw National Forest (Lane County); and Crater Lake National Park (Klamath County). Although it is present in the California Sierras, those sites are outside the range of the Northwest Forest Plan. *Hydrothyria venosa* is a North American endemic found in all major mountain ranges (McCune and Geiser 1997). In the Pacific Northwest it ranges from the California Sierra Nevada Mountains to southeast Alaska (Geiser *et al*. 1998).

D. Habitat Characteristics and Species Abundance

Hydrothyria venosa grows in clear flowing mid- to high-elevation streams where water quality appears to be very good (Dennis *et al.* 1981). This aquatic lichen grows primarily on small to medium rocks or bedrock and occasionally on wood, or partially buried in loose gravel in small, cool, clear perennial streams between 1150-7000 ft (350-2133 m) elevation. It is also known from one site where it grows on the concrete head box walls of a fish hatchery that has constantly circulating cold water, and a few small thalli were found on the inside of a culvert where light is high. It is never abundant on the culverts. It is occasionally found on exposed rocks above low water levels, and can survive periodic desiccation in sites with high humidity. At sites where *H. venosa* occurs, it can be abundant. This species is considered to be uncommon throughout its range, which could reflect limited dispersal between streams, narrow habitat requirements, and/or the few lichen surveys, which have typically focused on terrestrial habitats.

An informal survey of the H.J. Andrews Experimental Forest suggested that water quality, stream gradient, and substrate may be more important factors than canopy cover and forest age in determining presence of *H. venosa* (Daly 1991). It was not found in streams with gradients greater than 20%, or in higher gradient stream reaches in colonized streams, presumably because of the increased friction and turbulence of flow in steeper-gradient streams, and it was not found in many streams that appeared to be suitable habitat, suggesting that dispersal mechanisms

between different streams are limited (Daly 1991). Dispersal vectors are unknown, although flowing water, birds such as dippers, and aquatic insects are presumed to aid in dispersal. A doctoral student at Arizona State University is studying the ecophysiology and habitat characteristics of *H. venosa* and other aquatic lichens (Williams, pers. comm.), which will increase our knowledge about this species.

II. CURRENT SPECIES SITUATION

A. Why Species is listed under Survey and Manage Standard and Guidelines

Hydrothyria venosa was thought to be at risk under the Northwest Forest Plan because of its rarity and limited distribution in the range of the northern spotted owl. At the time of the FEMAT viability analysis, this species was known from 21 sites (USDA and USDI 1994a,b).

B. Major Habitat and Viability Considerations

The major viability consideration for *H. venosa* is loss of populations resulting from management activities that harm the local populations or affect their habitat.

C. Threats to the Species

Threats to *H. venosa* are those actions that alter stream conditions including water quality, chemistry, temperature, light regime, level, opacity, or sediment load, or reduce stream-bank stability, or alter microclimatic conditions associated with the riparian vegetation. Fish habitat enhancement projects that involve placement of instream structures that affect local populations are a threat. Building and decommissioning roads (including culvert placement and removal) and restoration activities may also pose a threat by directly removing or manipulating occupied substrate or by generating short-term sediment pulses when operating upstream of colonized stream segments. Run-off from fertilizers could also threaten local populations. Aquatic ecosystems are particularly responsive to chemical stress because pollutants tend to be well distributed throughout zones of active mixing (Ford 1989).

D. Distribution Relative to Land Allocations

All known sites of *H. venosa* are in Riparian Reserves (USDA and USDI 1994c). The adjacent land allocations need to be determined.

III. MANAGEMENT GOAL AND OBJECTIVES

A. Management Goal for the Species

The goal for managing *Hydrotheria venosa* is to assist in maintaining species viability.

B. Objectives

Manage known sites on federal land by maintaining habitat, stream conditions, riparian forest structure, occupied and potential suitable substrate, and microclimatic conditions associated with *H. venosa*.

IV. Habitat Management

A. Lessons From History

Although *H. venosa* is known from the four major mountain chains in the United States and southern Canada (McCune and Geiser 1997), most of Appalachian Mountain populations have been extirpated, probably by habitat degradation (Dennis *et al.* 1981. Because many invertebrates may use this species and other aquatic lichens as food and habitat (Gerson and Seaward 1977), declines in aquatic lichens could impact these invertebrates which in turn provide food and nutrients to other components of aquatic and terrestrial ecosystems. Water quality has probably negatively affected this species at some sites. The sensitivity of lichens to air pollution is well documented. *Hydrothyria venosa*, like other nitrogen-fixing lichens, is probably sensitive to ozone, sulfur dioxide, nitrous oxides, and other air pollutants (Ryan and Rhoades 1992).

A transplant experiment of *H. venosa* and subsequent monitoring have been conducted to mitigate road decommissioning activities on the Gifford Pinchot National Forest (Derr 1998). Surveys in 1995 revealed individuals that were growing above and below culverts scheduled for removal, which prompted several questions: Could *H. venosa* be transplanted upstream? Would the transplants survive? How could transplant growth be monitored? To answer these questions, twenty colonized rocks in two different streams were carried to shallow pools above the culverts, and the lichen surface area on these transplants was monitored for two years. Nearly all transplants showed increases in lichen surface area after 13 months, in one case as high as 320% (Derr 1998). Only one transplant experienced a decline in surface area because the rock had flipped over, killing the lichen. These results suggest that transplantation and lichen surface area monitoring may be an appropriate mitigation for *H. venosa*.

B. Identifying Habitat Areas for Management

Known sites of *H. venosa* on federal land administered by the Forest Service and BLM within the range of the Northwest Forest Plan are identified as habitat areas where these management recommendations should be implemented. Habitat areas are defined as suitable habitat occupied by or adjacent to a known site.

C. Managing in Habitat Areas

Although *H. venosa* is restricted in its ecological distribution, there may be certain areas where it is locally common. If a population of *H. venosa* occurs in a project area, several factors should

be evaluated before proceeding with actions that could adversely affect individuals. Evaluate the importance of that population in relation to other known sites, and the contribution of that population to species persistence. Consider the landscape and ecological context of the population, factors such as the location of the populations in relation to other known populations, relative isolation of the population, ecological conditions at the site and how they compare to other known sites (typical or atypical), areal extent of the population and abundance of the lichen within the local population, and availability of potentially suitable habitat in the area.

Each local population should be maintained intact, however it may be acceptable to impact a small percentage of known individuals at a particular site if it has only minimal affect on the integrity of the local population. Special consideration should be given to populations near the edge of range of *H. venosa*, in watersheds where it is rare and of limited distribution.

After evaluating these considerations, and if a decision has been made to impact individuals in a project area, apply the following mitigation measures. Visit the site with a project coordinator to determine if proposed actions can be shifted upstream or downstream so large concentrations of individuals are not affected. If impacts are unavoidable, determine if any of the colonized rocks are small enough to be transplanted to suitable habitat above the project area. Transplant as many colonized rocks as possible, and monitor their vigor (Derr 1998). About a year after the project is completed, and most sediment has flushed downstream, relocate transplants below the project site.

- Because dispersal may be limited between streams, maintain *H. venosa* in each stream where it occurs.
- Determine the extent of local population with a site visit.
- Maintain habitat for the species at known sites on federal lands by maintaining stream conditions including water quality, chemistry, temperature, level, opacity, and low sediment levels, and maintaining stream-bank stability and microclimatic conditions (*e.g.*, light regime) associated with the riparian vegetation.
- Reduce sedimentation into populated streams by minimizing or avoiding impacts of road building, maintenance, restoration, and decommissioning activities, including culvert placement and removal.
- Evaluate upstream activities that could harm downstream populations.
- Evaluate effects of treatments to riparian vegetation and the potential for altered bank stability, sediment and nutrient input, and how known sites of *H. venosa* could be affected by those activities.
- Avoid the use of fertilizers and herbicides next to populated streams, including upstream reaches.

D. Other Management Issues and Considerations

Because *H. venosa* may provide habitat for aquatic invertebrates (USDA and USDI 1994a), its declines could impact ecological functions and food web relationships important to fish and other components of aquatic and terrestrial ecosystems. *Hydrothyria venosa* fixes nitrogen and

contributes an unknown amount of nitrogen to aquatic ecosystems; removing a local population could have unknown effects on the nutrient cycles of the stream. This species is a good indicator of water quality (USDA and USDI 1994a) and can be sensitive to changes in water chemistry, temperature, light regime, level, opacity, or sediment load. Known sites should be evaluated at the sub-basin scale because activities far from the site may adversely affect it if they alter upper reaches of the stream. If *H. venosa* is in a project area, evaluate its distribution and abundance in a particular stream. If the species is well-distributed in the stream above a project area, evaluate suitable habitat below the project area, and the likelihood that *H. venosa* will be able to repopulate areas affected by management activity. The highest priority should be given to those sites where management activities may alter stream hydrology or aquatic conditions.

V. RESEARCH, INVENTORY, AND MONITORING NEEDS

The objective of this section is to identify opportunities to acquire additional information which could contribute to more effective species management. The content of this section has not been prioritized or reviewed as to how important the particular items are for species management. The inventory, research, and monitoring identified below are not required. These recommendations should be addressed by a regional coordinating body.

A. Data Gaps and Information Needs

- Revisit a representative sample of known sites to verify their status, determine extent and abundance of individuals in a stream, and characterize ecological conditions.
- Determine if *H. venosa* meets the criteria for being closely associated with late-successional and old-growth forests.
- Determine the natural range of riparian canopy conditions necessary for survival of *H. venosa*.

B. Research Questions

- Do individuals scattered along the length of a stream comprise more than one local population?
- Conduct genetic studies to determine if individuals scattered along the length of a stream represent more than one local population.
- What are the dispersal rates, distances, and mechanisms of *H. venosa*?
- Which habitat characteristics and ecological conditions are necessary for establishment of propagules and survival of established thalli?
- What are the seasonal, annual, or between-flood-event fluctuations in cover of *H. venosa* in a colonized stream?
- How could individuals be distributed in a stream to optimize recolonization into lower stream reaches?
- How do *H. venosa* and aquatic insects interact?
- What ecological roles does *H. venosa* play in aquatic and adjacent terrestrial ecosystems?

- What is the genetic relation between *H. venosa*, *Leptogium rivale*, and *Nostoc* in the same stream? How do these species interact?
- Do upstream populations of *H. venosa* colonize lower stream reaches?

C. Monitoring Needs and Recommendations

- Monitor sites of restoration activities, where roads are built or decommissioned, and culverts are removed or placed.
- Monitor transplanted populations for changes in surface area, biomass, and vigor.
- Monitor streams for dispersal of *H. venosa* where it has been reintroduced.

REFERENCES

Daly, W.J. 1991. Habitat characteristics of the aquatic lichen *Hydrothyria venosa* in the Cascade Range in Oregon. Unpublished report for an independent study class, Oregon State University, Corvallis. 8 p.

Dennis, W.M, P.A. Collier, P. DePriest and E.L. Morgan. 1981. Habitat notes on the aquatic lichen *Hydrothyria venosa* Russell in Tennessee. The Bryologist 84:402-403.

Derr, C.C. 1998. Transplanting and monitoring the aquatic lichen *Hydrothyria venosa*. Gifford Pinchot National Forest, Mount St. Helens National Volcanic Monument. Published abstract, Northwest Scientific Association Annual Meeting, The Evergreen State College, Olympia, WA.

Fink, B. 1935. The lichen flora of the United States. University of Michigan Press, Ann Arbor. 426 p.

Ford, J. 1989. The effects of chemical stress on aquatic species composition and community structure. *In*: Levin, S.A., M.A. Harwell, J.R. Kelly and K.. Kimball, eds. Ecotoxicology: Problems and Approaches. Springer Advanced Texts in Life Sciences. Springer-Verlag, New York, NY.

Geiser, L.H, K.L. Dillman, C.C. Derr and M.C. Stensvold. 1998. Lichens and allied fungi of southeast Alaska. pp. 201-244. *In*: M.G. Glenn, R.C. Harris, R. Dirig and M.S. Cole (eds.). *Lichenographia Thomsoniana*: North American Lichenology in Honor of John W. Thomson. Mycotaxon. 445 p.

Gerson, U. and M.R.D. Seaward. 1977. Lichen-invertebrate associations. *In*: Seaward, M.R.D. (ed.). Lichen Ecology. Academic Press, London, England.

McCune, B. and L.H. Geiser. 1997. Macrolichens of the Pacific Northwest. Oregon State University Press, Corvallis, OR. 386 p.

Ryan, B. and F. Rhoades. 1992. Lichens, bryophytes and air quality in Pacific Northwest wilderness areas. *In*: J. Peterson, D. Schmoldt, D. Peterson, J. Eilers, R. Fisher, and R. Bachman. Guidelines for Evaluating Air Pollution Impacts on Class 1 Wilderness Areas in the Pacific Northwest. Gen. Tech. Rep. PNW-GTR-299. USDA Forest Service, Pacific Northwest Research Station. Portland, OR. 83 p.

USDA Forest Service and USDI Bureau of Land Management. 1994a. Final supplemental impact statement on management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl, Appendix A, Forest Ecosystem Management: An Ecologic, Economic, and Social Assessment. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994b. Final Supplemental Environmental Impact Statement on Management of Habitat for Late-Successional and Old-Growth Forest Related Species within the Range of the Northern Spotted Owl, Appendix J2, Results of Additional Species Analysis. Portland, OR.

USDA Forest Service and USDI Bureau of Land Management. 1994c. Record of decision for amendments to Forest Service and Bureau of Land Management planning documents and standards and guidelines for management of habitat for late-successional and old-growth forest related species within the range of the northern spotted owl. Portland, OR.

Williams, W.C. 1995. Research proposal for *Hydrothyria venosa* and other aquatic lichens. Arizona State University, Tempe, AZ.